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TEST REPORT

PRELIMINARY RS - 6A PROTOTYPE #2

34
DOC 33 REV DATE 2/5/80 BY 37169
ORIG COMP 35 OPI 56 TYPE 30
ORIG CLASS M PAGES 18 REV CLASS U
JUST _____ NEXT REV _____ AUTH: HR 70-2

24 March 1953

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1. - INTRODUCTION

Prototype Model #2 of the RS-6A was submitted to the Analysis and Appraisal Unit of Research and Development for prototype approval testing. The following tests were conducted to determine whether or not the set meets specifications.

2. SUMMARY

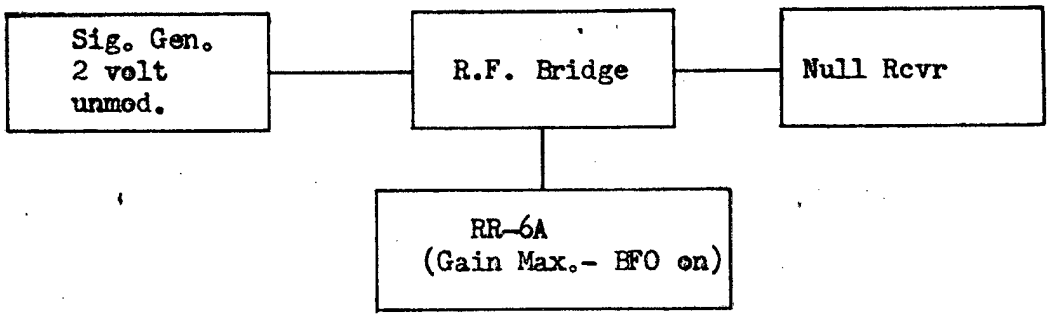
The RS-6A is an extended range copy of the RS-6 covering the frequency spectrum between 4.5 and 22 mcs. Except for a few minor electrical and mechanical changes, it is a duplicate of the RS-6.

Excessive crystal current, failure to key properly, and faulty plugs and sockets are some of its shortcomings which warranted rejection of the unit as a prototype.

3. Receiver Tests

3.1. Antenna Input Impedance

Band	Frequency (mcs)	Impedance (ohms)
Low	4.5 7.0 10.0	233 367 418
High	10.0 16.0 22.0	233 310 221



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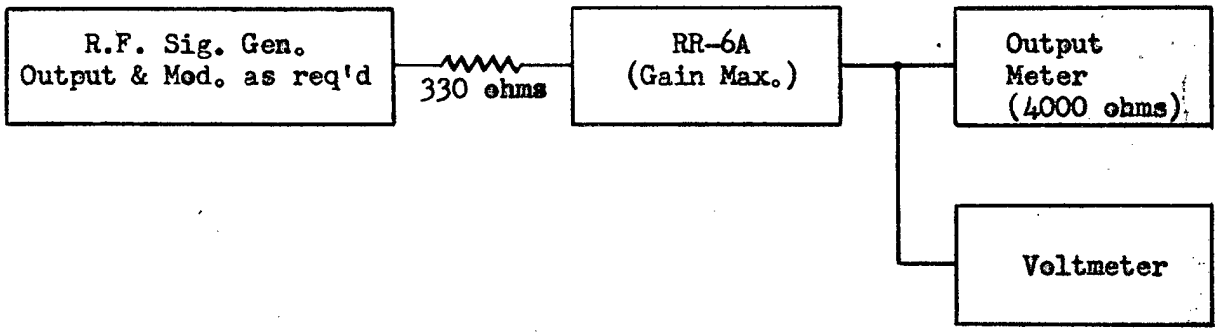
3.2. Sensitivity

Freq. (mcs)	Raw Noise		10 db. S/N		* Raw Sensitivity	
	AM BFO off. (uw)	CW BFO max. (mw)	** AM BFO off. (uv)	CW BFO max. (uv)	AM BFO off. (uv)	CW BFO max. (uv)
4.5	0.63	0.18	2.0	1.9	13.5	4.2
7.0	0.40	0.09	1.75	1.35	12.4	3.7
10.0	0.63	0.22	1.60	1.35	11.3	3.0
10.0	0.40	0.10	2.5	1.25	15.0	5.3
16.0	0.40	0.03	3.2	1.35	22.0	7.0
22.0	0.90	0.30	2.9	2.60	19.0	4.8

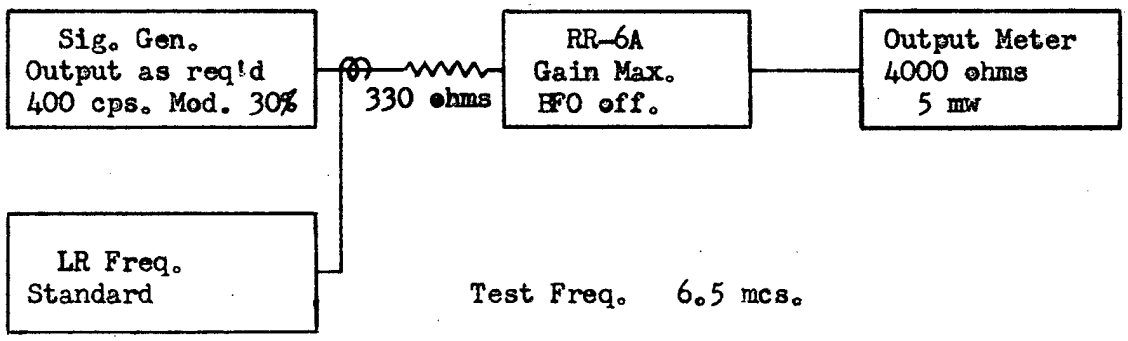
* Input for output of 5 mw.

** $\frac{\text{Carrier + Mod. + Noise}}{\text{Noise}}$



3.3. Selectivity

See Graph of Figure #1



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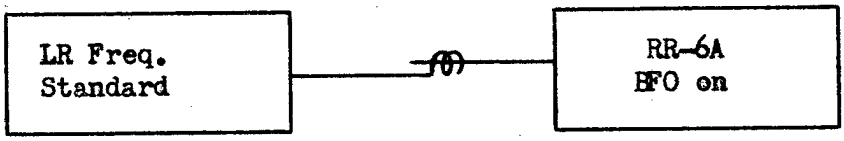
3.4. Stability

3.4.1. Frequency Stability During Warm-Up

See Graph of Figure #2



3.4.2. Frequency Stability Vs. Line Voltage

Frequency (mcs)	Line Voltage (volts)	Deviation (cps)	Stability %
7.0	100 110 120 130	Freq. Shift less than 400 cps.	0.0057
16.0	100 110 120 130	0 -200 -800 -1400	0.0088

Same test set-up as used in Section 3.4.1.
Nominal Line Voltage: 120 V.A.C.

3.4.3. Hand Capacity Effect

With the receiver tuned to 7 mcs. it is possible to shift the L.O. frequency 100 cycles by hand capacity. At 16 mcs. it can be shifted 200 cycles.

3.4.4. Mechanical Stability

At 7 mcs., with abnormally rough handling, the L.O. frequency shifted 1.25 kcs.

At 16 mcs., with abnormally rough handling, the L.O. frequency shifted 2.0 kcs.

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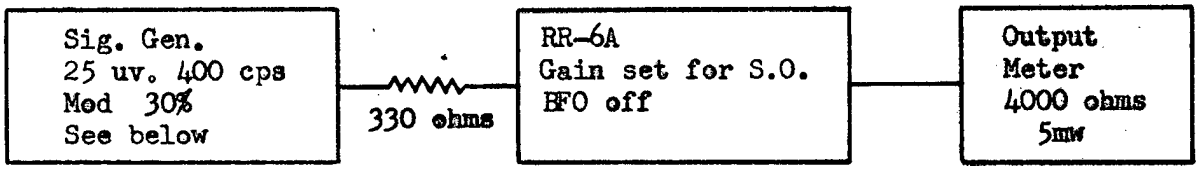
3.5. Image Rejection Ratio

Frequency (mcs)	Rejection Ratio (db)
4.5 7.0 10.0	55 40 32.5
10.0 16.0 22.0	42 30 26



The signal generator output, at the image frequency, was adjusted so that the audio output meter indicated standard output.
(I.F. Freq. = 456 kcs.).

3.6. I. F. Rejection Ratio

Frequency (mcs)	Rejection Ratio (db)
4.5 7.0 10.0	80.0 84.5 83.0
10.0 16.0 22.0	84.0 83.2 92.5

The test set-up was the same as used in Section 3.5 except that the signal generator output at the I.F. frequency was adjusted to obtain standard audio output from the RR-6A.

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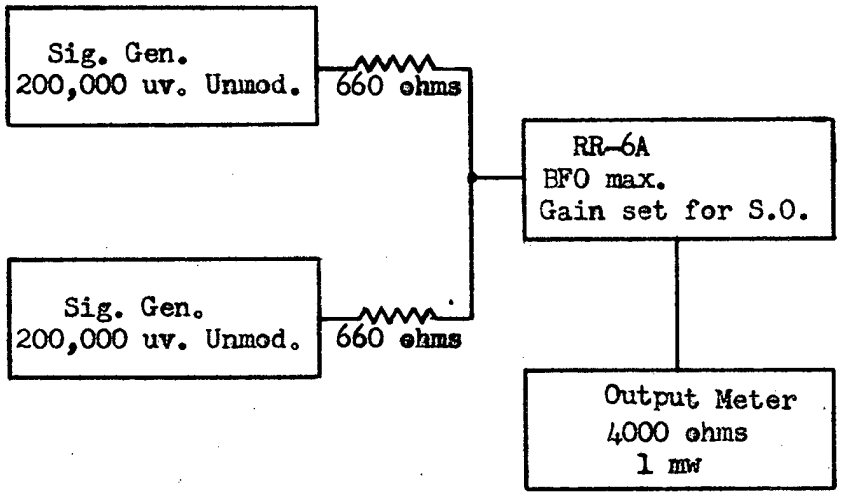
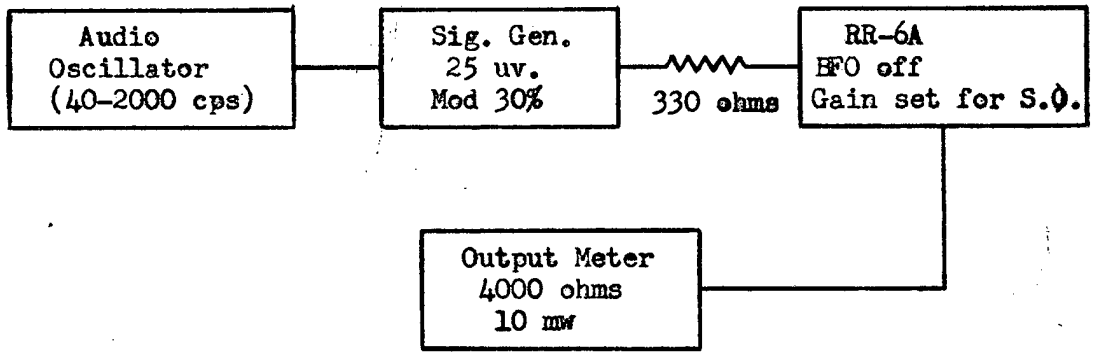
3.7. Cross Modulation Products

Band	Test Frequency	Cross Signal Rejection (db)
Low	4.6 mcs.(diff. freq.) 10.0 mcs.(sum freq.)	87.7 83.9
High	10.0 mcs.(diff. freq.) 22.0 mcs.(sum freq.)	96.5 94.0



3.8. Overall Audio Response

See Graph of Figure #3



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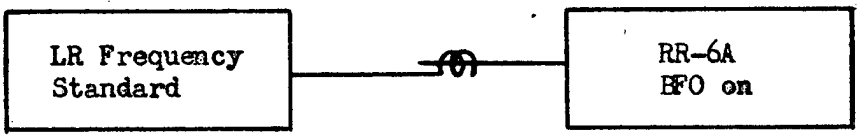
3.9. Tuning Dial Accuracy

Frequency (mcs.)	Error %
4.5	0.31
7.0	0.58
10.0	0.19
10.0	0.01
16.0	0.37
22.0	0.18



3.10. Resettability

Frequency (mcs.)	Maximum Error %
7.0	0.04
16.0	0.07

Same test set-up as in Section 3.9.

3.11. Calibration Oscillator Accuracy

The calibration oscillator accuracy is in excess of an operator's ability to set the fiduciary hairline to the dial.

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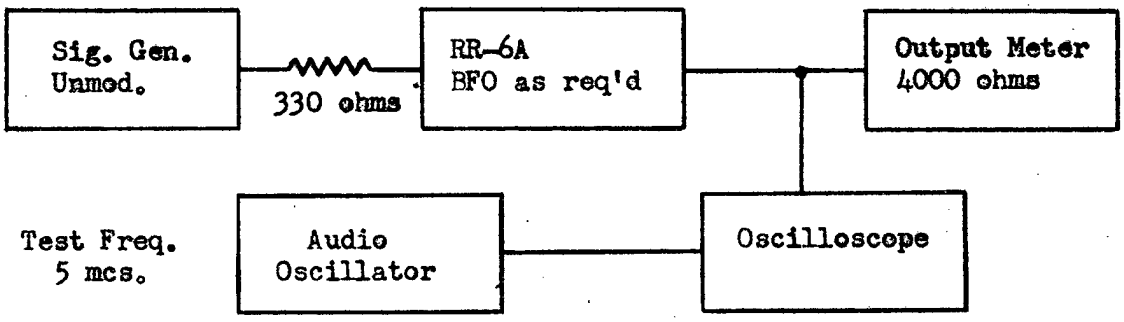
3.12. BFO Tuning Range

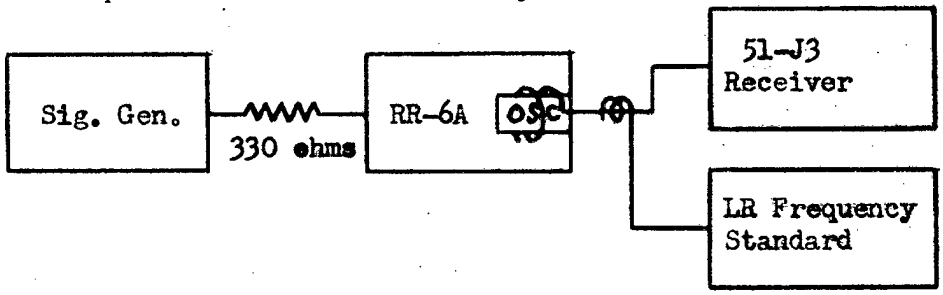
BFO Setting	Frequency (cps)
— Maximum	3850
— 3	3050
— 2	1950
— 1	1050
0	0
1	1425
2	2700
3	3400
Maximum	3250



3.13. Local Oscillator Pulling

7 mcs. Reducing the receiver gain from maximum to minimum pulls the oscillator 300 cycles.
Increasing the R.F. signal input from 2 to 200,000 microvolts pulls the oscillator 50 cycles.

16 mcs. Reducing the receiver gain from maximum to minimum pulls the oscillator 900 cycles.
Increasing the R.F. signal input from 2 to 200,000 microvolts pulls the oscillator 250 cycles.



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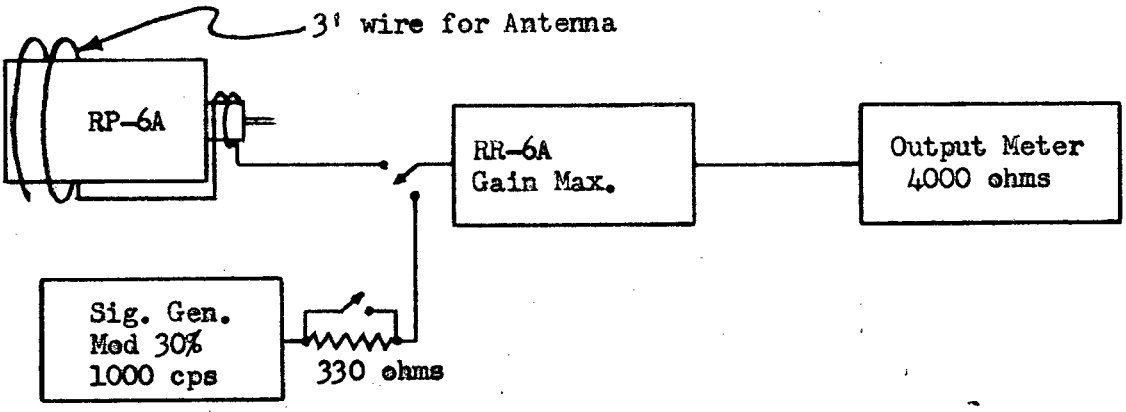
3.14. Equivalent Noise Input

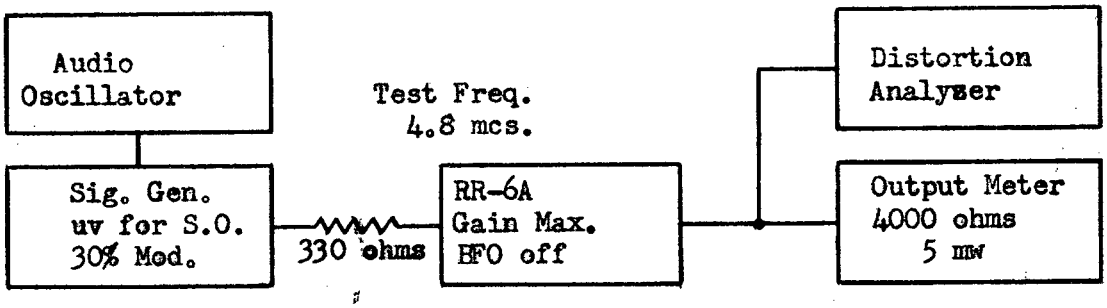
	No Dummy Antenna Used		330 ohms Dummy Antenna Used	
	BFO on	BFO off	BFO on	BFO off
Jones Plug Not Grounded	4.4 uv	2.5 uv	0.5 uv	3.0 uv
Jones Plug Grounded	4.4.uv	2.5 uv	0.5 uv	3.0 uv



1. All grounds made to ground plane in screen room.
2. RS-6 operated from a 6 volt battery
3. Test run at 10 mcs. on the low band (maximum output was indicated at this frequency using a 3' antenna wrapped around RP-6A).
4. Equivalent input in microvolts was found by using an R.F. signal generator.

3.15. Harmonic Distortion

Frequency (cps)	Fundamental %	2nd Harmonic Distortion %	3rd Harmonic Distortion %
300	100	5.0	1.0
600	100	3.5	0.3
1200	100	3.0	0.2
2400	100	3.5	0.15



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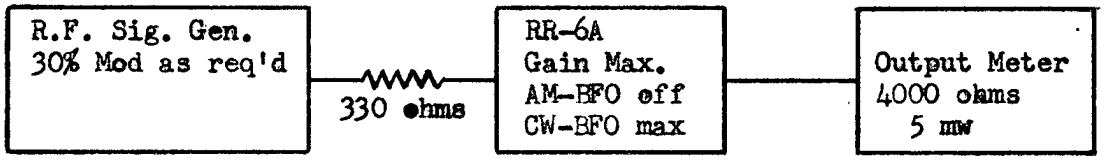
3.16. Crystal Operation of the Receiver

Operating Freq. of Crystal (mcs.)	Receiver & Sig. Gen. Freq. (mcs.)	Sensitivity for 5 mw Output (uv.)	
		AM	CW
5.0 (I)	4.5	18.0	5.4
10.0 (II)	9.5	10.7	3.8
15.0 (III)	14.5	28.0	16.0
7.0 (I)	6.5	13.7	4.2
14.0 (II)	13.5	13.7	10.8
21.0 (III)	20.5	32.0	*

* Could not obtain output without excessive input.



3.17. Receiver Radiation

Freq. (mcs)	Radiation in uv/meter				
	Fundamental	2nd Har.	3rd Har.	4th Har.	5th Har.
Local Oscillator					
.5	40,000	520	300	140	40
7.0	12,000	300	90	-	-
10.0	2,200	140	-	-	-
10.0	15,000	750	-	-	-
16.0	14,000	-	-	-	-
22.0	14,000	-	-	-	-
Calibration Oscillator					
0.5	5,000	1,200	160	60	-
B.F.O.					
.456	5,000	80	-	-	-

A.C. operation in screened room on ground plane in accordance with JAN I 225.

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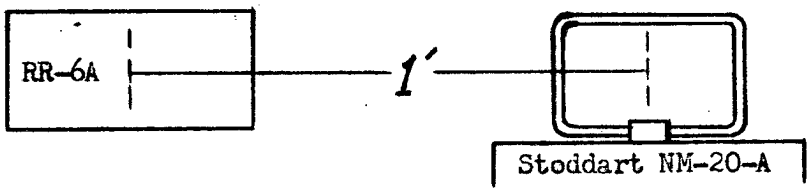

4. Transmitter Tests

4.1. Power Output

Freq. (mcs)	Power Output in Watts				
	73 ohms	146 ohms	300 ohms	600 ohms	1200 ohms
4.5	6.23	6.39	6.95	6.63	6.97
6.0	7.49		7.89		8.08
7.3	8.46		9.00		8.69
9.0 (II)	8.81		8.70		8.48
10.0 (II)	8.70	8.87	9.42	8.64	8.28
10.0 (II)	5.95	6.15	5.73	6.00	5.40
12.0 (II)	6.35		6.50		6.58
14.6 (II)	7.40		6.75		7.31
16.0 (III)	7.03		6.95		6.95
19.0 (III)	7.75		7.05		7.12
22.0 (III)	7.40	7.60	7.05	7.26	7.31

Laboratory average crystals were used and the line voltage was maintained at 120 volts.

4.2. Efficiency

Freq. (mcs)	Key Up	Key Down		
	Plate Input Pwr (watts)	Plate Input Pwr (watts)	Power Output (watts)	Efficiency %
4.5	8.70	21.2	6.95	32.7
7.3	8.45	20.0	9.00	44.9
10.0 (II)	8.45	19.4	9.42	48.5
12.0 (II)	8.40	21.5	6.50	30.2
16.0 (III)	8.42	21.5	6.95	32.3
22.0 (III)	8.30	18.7	7.05	37.7

Laboratory average crystals and a 300 ohm dummy antenna were used with the line voltage maintained at 120 volts.

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4.3. Crystal Current

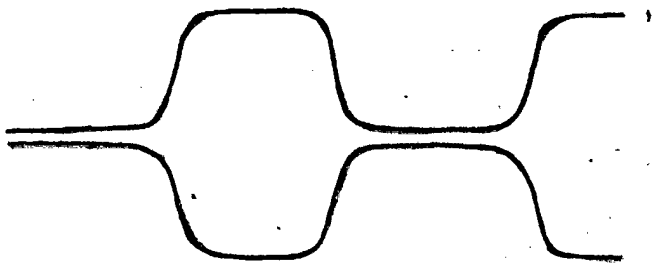
The crystal current varied from 35 to 62 milliamperes depending upon the crystal and frequency selected.

4.4. Keying Characteristics

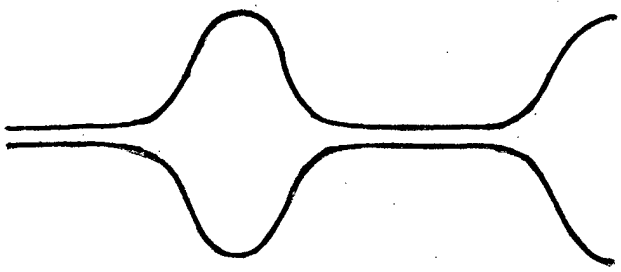
The keying characteristic of the RT-6A transmitter was checked every 200 kcs. from 4.5 to 22 mcs. With a keying speed of 60 wpm the resulting wave shape at each frequency was classified good, fair, or no good (see drawings below). The main trouble encountered was not from bad spikes or tails, but rather the reluctance of crystals to oscillate when doubling or tripling to certain frequencies, as represented by #3. This condition could usually be remedied by the addition of hand capacity to the crystal.

See curve of Figure #4.

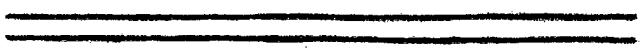
#1. Good



#2. Fair



#3. No Good



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4.5. Harmonic Radiation

Xmtr. Freq. (mcs)	Stoddart NM-20A Freq. (mcs)	Harmonic Radiation %
6.0	6.0	100.00
6.0	12.0	2.22
6.0	18.0	2.22
6.0	24.0	0.04
12.0	12.0	100.00
12.0	24.0	9.10
12.0	6.0	0.05
12.0	18.0	0.025

The Stoddart NM-20-A mast antenna was 6 feet from the transmitter 146 dummy antenna. (The test was conducted in a screened room on a ground plane).

4.6. Crystal Input Capacity

The correlation capacitance is less than 10 uuf., and is considered to be much too low. The Specifications as stated in Para. 5.3.6 require this capacity to be not less than 22 uuf., nor more than 26 uuf.

5. Conclusion

The RS-6A prototype is not satisfactory for the following reasons:

1. The receiver S/N ratio falls below specifications at 22mc/s (CW), all frequencies (AM) on the high band, and at 4.5 mc/s (CW).

Specifications		S/N Hi Band	S/N Lo Band
Para 4.6.3.1	CW	1.5	1.5
	AM	2.0	2.0

2. The selectivity curve is not symmetrical.

The Specifications state in Para 4.6.12.1 : The curve of I. F. selectivity shall be symmetrical about the I. F. frequency.

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5. Conclusion (continued)

3. The receiver drifted twenty Kc or 0.125% after a 10 minute warm-up period was allowed. The test frequency was 16 mc/s.

The Specifications state in Para 4.6.13 : The maximum frequency drift after 10 minutes warm-up shall not exceed 0.03% of the indicated frequency at any part of either band.

4. The equivalent noise input when measured as shown in Section 3.14 is excessive.

The Specifications state in Para 6.3.3.4 : The maximum value of noise under any consideration shall not introduce a greater amount of noise into the receiver than that equivalent to one microvolt of test signal, 30% modulated at 1000 cycles.

5. The local oscillator pulled 900 cycles with gain control variation and 250 cycles when the R. F. input was increased from 2 to 200,000 microvolts.

The Specifications state in Para 4.6.15 : Maximum oscillator frequency change with a variation in gain shall not exceed 100 cycles. Oscillator frequency change with variation in input signal shall not change more than 100 cycles between input signal levels of 2 microvolts and 200,000 microvolts.

6. Receiver radiation from the H.F.O. ranged from 2200 uv/m to 40,000 uv/m. B.F.O. and Calibration oscillator radiation was 5000 uv/m.

The Specifications state in Para 4.6.8.1.

H.F.O.	Hi Band	3500 uv/m
	Lo Band	1000 uv/m
B.F.O.		3 uv/m

7. Second Harmonic radiation from the transmitter when tuned to 12 mc/s was 9% on the high frequency band.

The Specifications state in Para 5.3.8 : In no case shall the harmonic output exceed 12% on the second and 5% on the third and higher frequencies for low band operation. For high band operation it shall not exceed 5% on the second and 1% on the third.

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5. Conclusion (continued)

8. Crystal current varies between 35 and 62 milliamperes. Forty milliamperes is considered the maximum tolerable when using FT 243 crystals.

9. The keying characteristics of the RT-6A is not acceptable. (See Para 4.4 and the curve of Figure #4). It did not key at some frequencies.

10. The correlation capacitance is less than 10 uuf., and is considered to be much too low. The Specifications state in Para 5.3.6. : This capacity shall be not less than 22 uuf., nor more than 26 uuf.

11. The interconnecting plugs did not mate securely.

12. The Jones plug and socket used during battery operation were intermittent.

13. The transmitter loading knob falls off.

14. The "key" markings on the Amphenol plugs are not properly placed.

15. Schematic diagrams should be provided.

16. The hook-up block diagrams in the accessory unit should refer to the RT-6A, RR-6A, etc., instead of to the RT-6, RR-6, etc.

6. Recommendation

It is recommended that the faults listed in the Conclusion section be remedied and that the units be resubmitted for prototype inspection.

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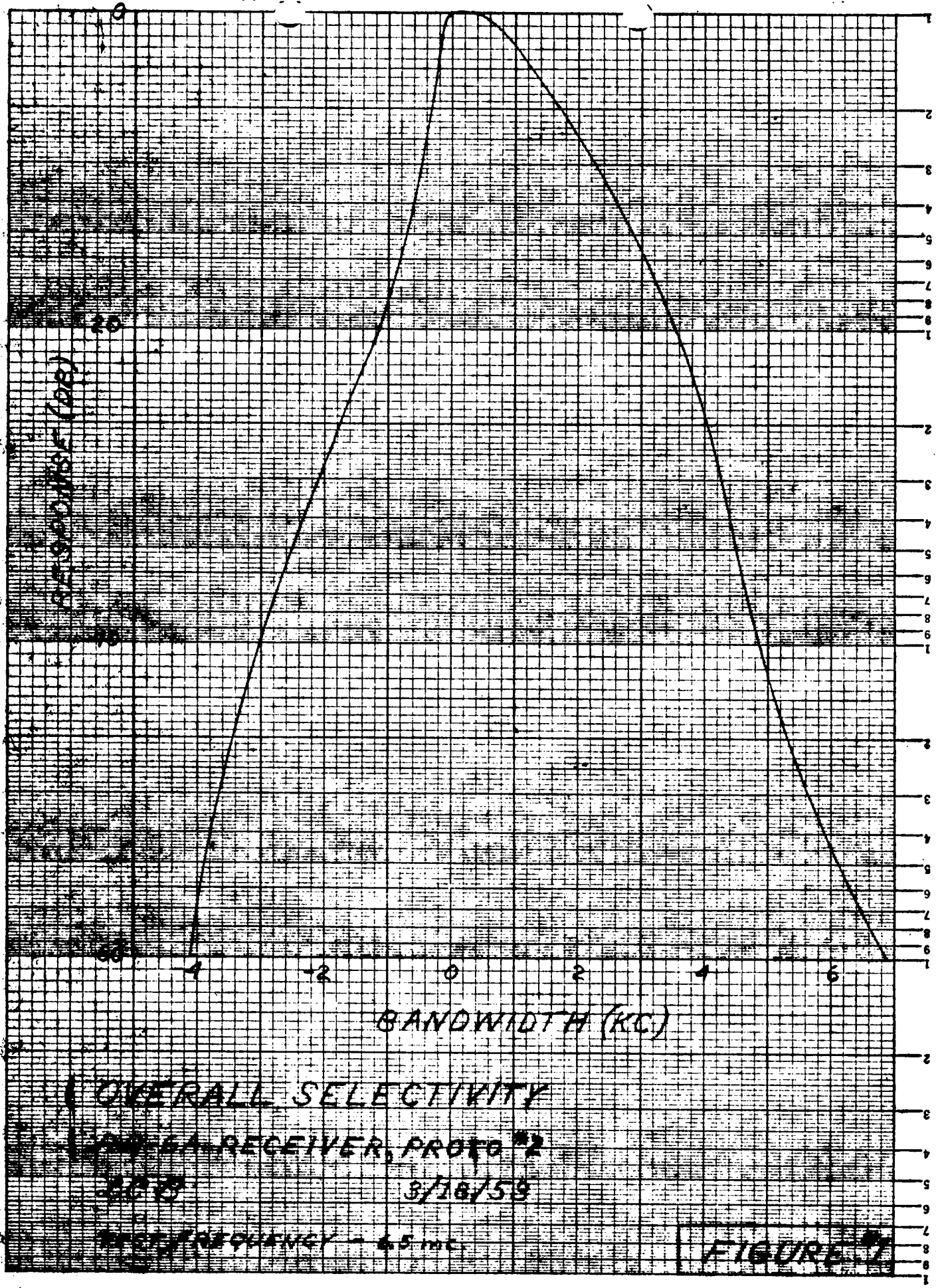

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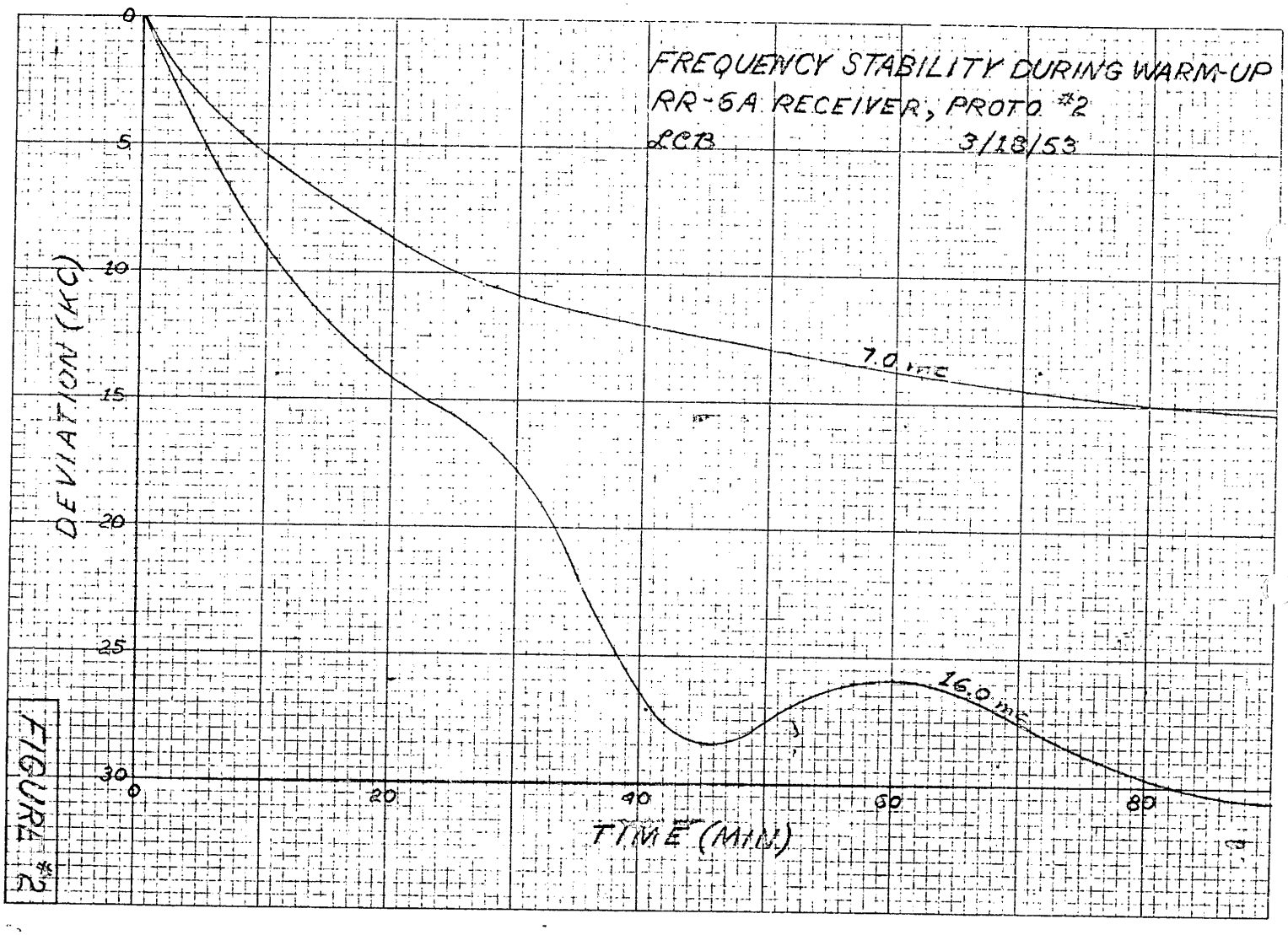

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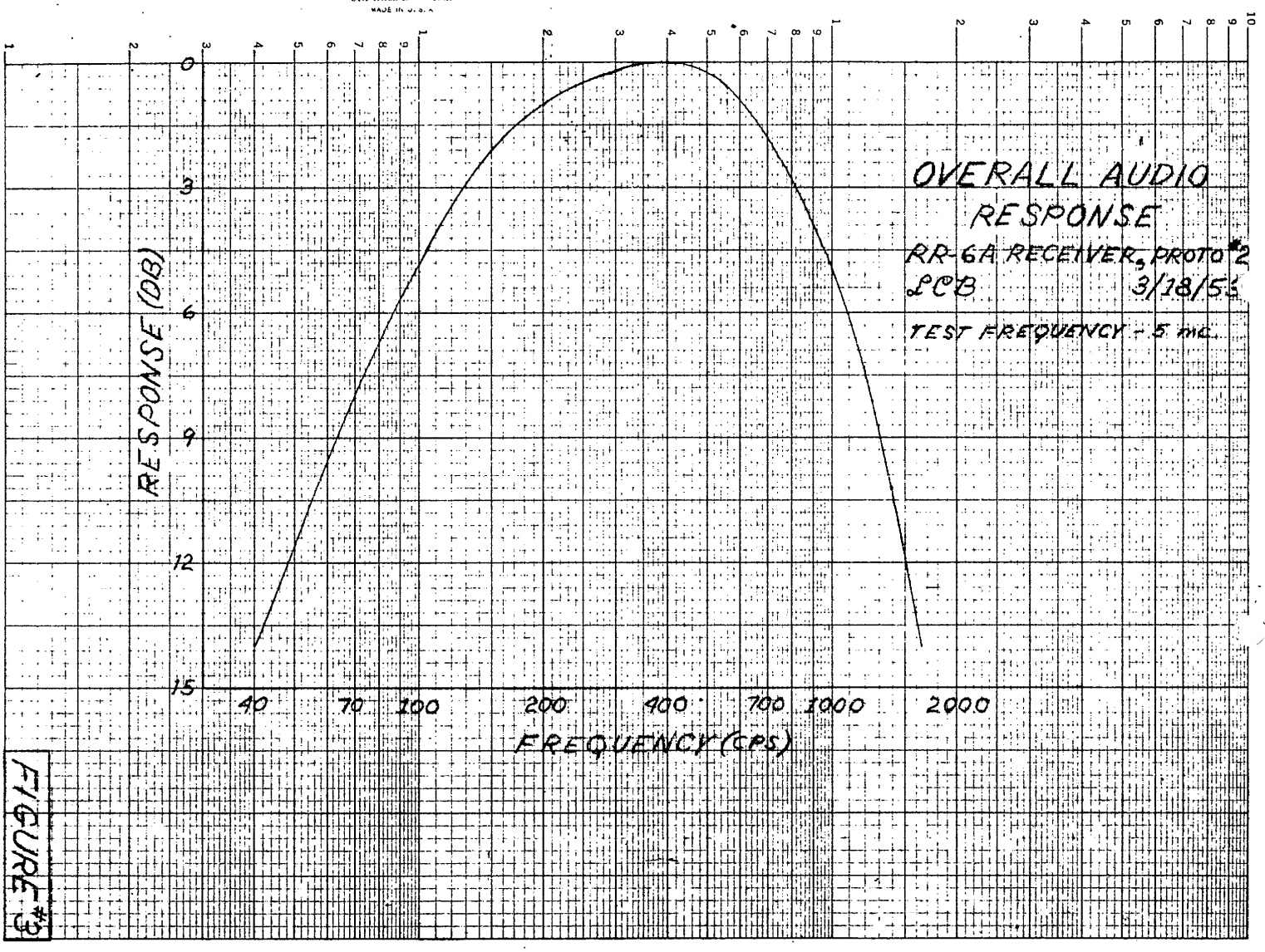

FIGURE #3

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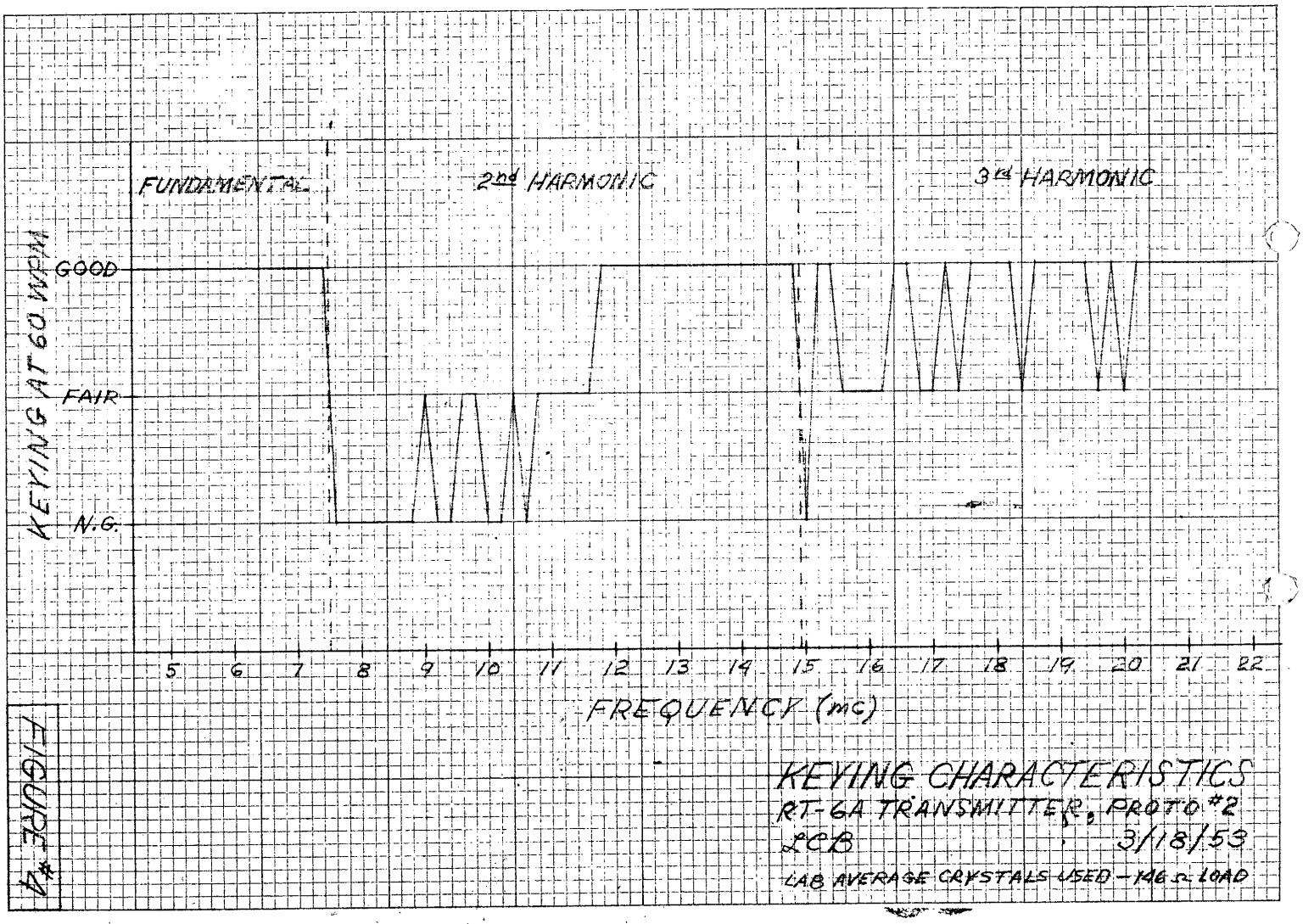

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